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(54) Impacting type of seismic source for use in earth strata

(57) A seismic source is produced by striking a bar inserted in a hole (2) in strata, eg. a coal seam, with an impact mechanism (7). Energy from a striking element (9) of the mechanism (7) is transferred by the bar (3) to the surrounding strata (1). The bar (3) e.g. of nylon has similar acoustic properties to the strata (1). Movement of the bar can be detected by a magnet and coil arrangement (6, 5) associated with the bar in order to create a time break signal for initiating a recording process, monitoring the time of impact and to generate a signature of the source. The striking element (a) is driven by an hydraulically triggered gas spring device.

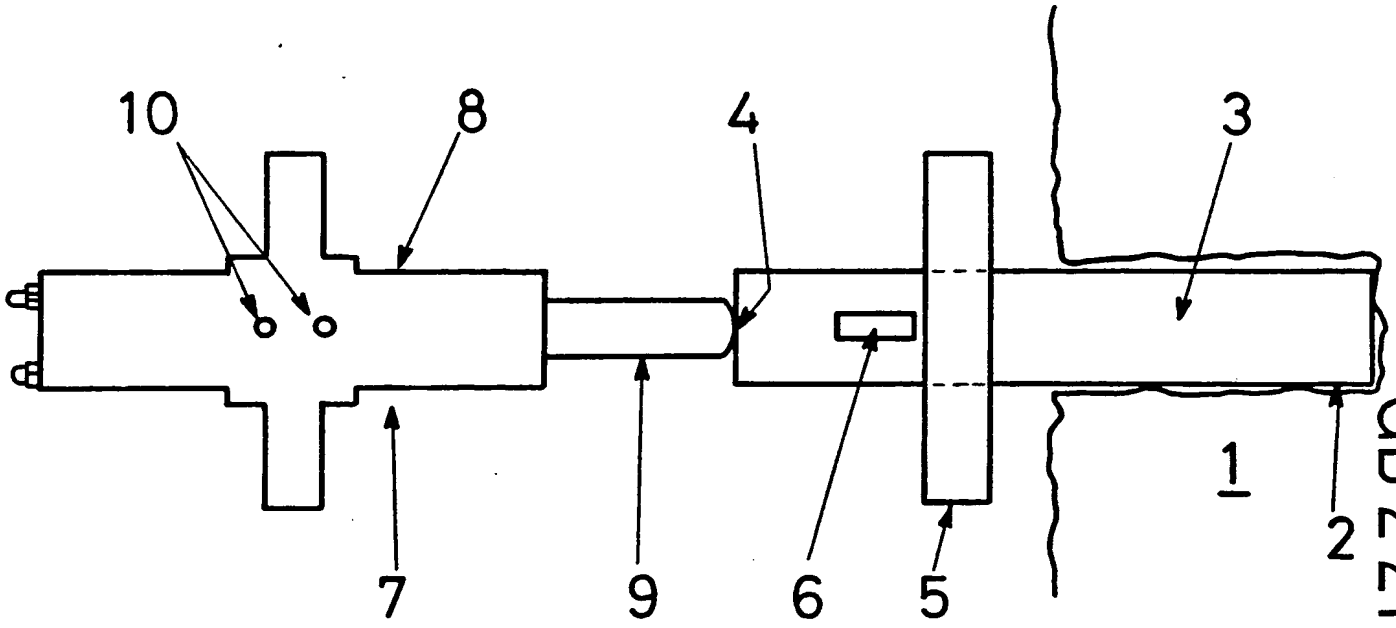

FIG. 1.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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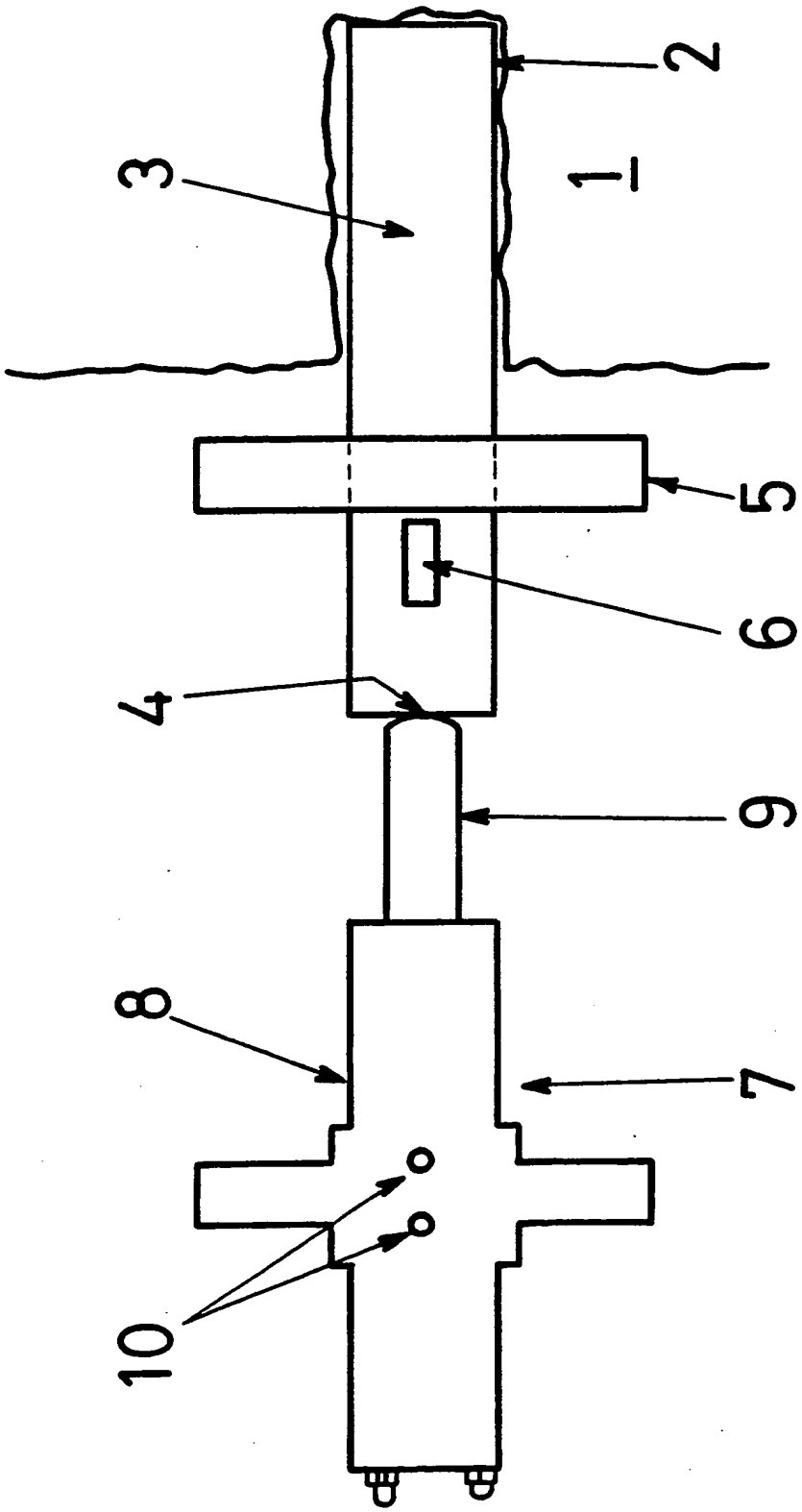

FIG. 1.

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IMPROVED SEISMIC SOURCE

This invention relates to a method and also an apparatus for providing an improved form of seismic source for generating shear waves in a seismic detection system.

When prospecting and analysis of rock strata are being undertaken by seismic means it is usually the practice for a seismic source of an explosive nature to be detonated at one point and for geophones or other detectors to pick up the waves created by the source as they pass through the intermediate strata and for these waves to be recorded and subsequently analysed in order that the nature of the strata may be determined.

The use of normal explosive charges means that a point source of energy is used and the energy from that source is propagated in all directions through the strata without any control over the polarisation of that energy. A number of recently developed exploration techniques require the use of shear waves, in-seam seismic exploration being one example. In-seam seismic exploration requires a seismic source to generate seismic pulses in one part of the seam which can then be propagated as horizontally polarised shear waves, known as channel waves, through the seam to detectors

in another part thereof. Clearly a source which can preferentially release its energy in the plane of the seam will be more efficient for in-seam seismic exploration than an uncontrolled source as it will produce more of the desired energy and less seismic noise for a given total available source energy.

It is an object of this present invention to provide an improved seismic source which enables shear energy to be released by design and which is suitable for many applications specifically but not exclusively, in-seam seismic work.

A well known method that produces polarised seismic energy comprises impacting a weight upon a bar placed in a hole drilled in the strata under investigation.

According to the present invention a method of producing an in-seam seismic source comprises drilling a hole in the coal seam, inserting a longitudinally extending bar into the hole, placing an impact mechanism adjacent to the end of the bar nearest the mouth of the hole, causing the impact mechanism to strike the end of the bar and to dissipate energy through the bar and into the surrounding strata.

The bar has acoustic properties similar to those of the surrounding strata so that a more efficient energy transfer from the bar to the strata can take place. A plastics material may be conveniently used particularly if the stratum is coal and an example of suitable plastics material is Nylon 66.

The impact machine may obtain its energy from a gas spring which is conveniently charged for use by a hand pump.

Means are provided whereby a 'Timebreak' signal, used to

initiate the seismic recording system, may be obtained and this means may include a magnetic pick up coil placed around the bar and through which the bar moves when impacted so as to cause a voltage to be induced in the coil. If the bar is itself magnetic then this signal is readily induced. If, however, the bar is of a non-magnetic nature then a suitable magnet is incorporated into the bar in the vicinity of the coil. This signal may further be used to monitor not only the time of the impact but also the nature of the impact.

The invention also includes within its scope, apparatus for carrying out the method thereof including an impact mechanism, an associated bar adapted in use to be struck by the impact mechanism and an indicating arrangement associated with the bar for detecting the motion of the bar.

In order that the invention be readily understood, one example of the method and apparatus thereof will now be described with reference to the accompanying drawing

Referring now to the drawing, Figure 1, this shows a coal seam 1 in which a hole 2 has been drilled. A plastics bar 3 is inserted into the hole and the free end 4 of the bar is projecting out of the hole 2 and passes through a coil 5. The bar 3 has a magnet element 6 embedded in it. In this example the bar 3 is made of a nylon material and this material was chosen because it has very similar acoustic properties to those of the coal seam 1.

An impact mechanism shown generally at 7 comprises a body 8 and a chisel member 9. The chisel member 9 can move longitudinally along the axis of the body 8 and is driven indirectly by a gas

spring device mounted within the body 8. The gas spring is compressed by the action of an internal piston which is in turn driven by hydraulic fluid entering the body 8, through the ports 10 from an hydraulic hand pump (not shown). In use, the impact mechanism is placed adjacent to the end 4 of the bar 3 and the hand pump is operated until the impact mechanism automatically releases its energy causing the chisel 9 to move sharply forward and strike the bar end 4 and create a compressive force on the bar 3. This compressive force can be released from the bar into the strata to appear as shear waves with their displacement amplitude and their propagation direction in the plane of the coal seam 1. The polarisation of the source energy can be adjusted by altering the direction of the hole.

As the bar 3 receives the impact from the chisel 9 it moves the magnetic member 6 embedded in it relative to the coil 5 and induces a current in the coil 5. This coil is connected to the recording mechanism and indicates the 'Timebreak' signal at the moment of impact. The shape of the voltage output from the timebreak coil 5 is an electrical analogue of the shape of the pulse travelling along the bar and can be used as a source signature.

In use, this source has been found to produce highly repeatable seismic signals when fired in a given hole. The seismic signals received by the detecting geophones and recorded by the recording mechanism, for successive impacts, may be stacked to enhance the overall signal to noise ratio. The timebreak coil signal can be used to determine the acceptability of each successive impact for stacking purposes.

The apparatus and method of the invention is very simple to use as will be appreciated since the impact mechanism 7 is of a relatively small size and weight and can be made portable.

The invention is also safe to use as the energy originate from a hand operated hydraulic pump and the use of explosive charges is avoided.

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1. A method of producing a seismic source comprising drilling a hole in a strata, inserting a longitudinally extending bar having similar acoustic properties similar to those of the strata in the hole, placing an impact mechanism adjacent to the end of the bar nearest the face of the strata, causing the impact mechanism to strike the end of the bar and to radiate seismic energy from the bar into the strata.

2. The method as claimed in Claim 1, wherein the stratum is coal and the bar is a plastics material.

3. The method as claimed in Claim 2, wherein the bar material is Nylon 66.

4. A method as claimed in any preceding claim including an impact mechanism having a gas spring as the store of energy.

5. The method as claimed in Claim 4, wherein the gas stored in the gas spring is nitrogen.

6. The method as claimed in any preceding claim and including producing a timebreak by magnetically inducing a voltage in a coil surrounding the bar member.

7. The method as claimed in Claim 6 wherein the bar is of a non-magnetic material and includes a magnetic element embedded in the bar.

8. The method as claimed in Claim 6 or Claim 7 wherein a signal voltage produced by the coil member is used as a source signature.

9. The method as claimed in Claim 8 whereby the source signature is used to decide if the seismic signals from a given

impact are of a sufficient quality to be stacked.

10. The method of producing an in-seam seismic source substantially as hereinbefore described and with reference to the accompanying drawing.

11. Apparatus for use with a method of any preceding claim and comprising an impact mechanism, an associated bar adapted in use to be struck by the impact mechanism and an indicating arrangement associated with the bar for determining movement of the bar.

12. Apparatus substantially as hereinbefore described and with reference to the accompanying drawing.

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